REMARKS

Claims 1-108 are pending in the application. Claims 18-39, 44-94, and 97-108 have been withdrawn, as they are drawn to a separate invention not previously elected for examination. In view of the Examiner's earlier restriction requirement, Applicant retains the right to present claims 18-39, 44-94, and 97-108 in a divisional application. Claim 3 has been cancelled without prejudice to the underlying subject matter. Claims 1-2, 11, and 17 have been amended to further clarify the electrode structure of the present invention.

Claim Objections

Claim 3 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant respectfully submits that this objection is moot in light of the cancellation, without prejudice, of claim 3 as noted above.

Claims 2 and 11 are objected to based on an informality. Specifically, the Examiner asserts that "semiconductive" should be "conductive." Applicant respectfully submits that the objection is moot in light of currently amended claims 2 and 11.

35 U.S.C.§ 112 Rejections

Claims 4-5 and 17 stand rejected under 35 U.S.C.§ 112, second paragraph, as being indefinite. Applicant respectfully traverses this rejection.

With regard to claims 4 and 5, the Office Action asserts that the term "an oxide" recited in these claims renders them indefinite because the term "is not defined by the claim, the specification does not provide a standard for ascertaining the requisite

degree, and one of ordinary skill in the art would not be reasonable apprised of the scope of the invention." (Office Action at 3). The Office Action further states that in this instance, "it is not clear where an oxide is." (Office Action at 3).

Claims 4 and 5 depend from independent claim 1, which recites an "electrode structure," comprising, among other things, "a first layer of conductive material." Claim 4 further defines the "first layer" as being "a metal that adheres to an oxide." Similarly, claim 5 further defines the "first layer" as being "a metal that is diffusible into an oxide and bonds to an oxide." Thus, claims 4 and 5 recite properties of the "first layer of conductive material," as recited in claim 1, but do not refer to any particular oxide layer. As such, disclosure of the position of a particular "oxide layer" is not necessary. For at least the above-stated reasons, Applicant respectfully requests that this rejection be withdrawn.

With regard to claim 17, the Office action asserts that the term "the TEOS" recited in the claim lacks a sufficient antecedent basis. As noted above, claim 17 has been amended to further clarify the electrode structure of the claimed invention. Applicant respectfully submits that the rejection is moot in light of the current amendment.

35 U.S.C.§ 102 Rejections

Claims 1-2, 7-8, 12, 15, 40-43, and 95 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Dalton et al. (US 2002/0145200 A1) ("Dalton"). Applicant respectfully traverses this rejection.

The claimed invention relates to an electrode structure for use in integrated circuits and more particularly to electrode structures that exhibit good adhesion

between different conductive layers during fabrication. As such, currently amended independent claim 1 recites an electrode structure comprising:

> a first layer of conductive material;
>
> a dielectric layer formed on a surface of the first layer;
>
> an opening formed in the dielectric layer to expose a portion of the surface of the first layer;
>
> a binding layer formed on the dielectric layer and on the exposed portion of the surface of the first layer; and
>
> a second layer of conductive material formed on the binding layer.

Such a device is not anticipated by Dalton.

Dalton does not disclose all the limitations of claim 1. Specifically, Dalton fails to disclose a "binding layer." Instead, Dalton discloses an optional liner layer (26), designed to "prevent the diffusion of Cu into the dielectric layers." (Paragraph 51). Suitable liner layer materials disclosed by Dalton include TiN, TaN, W, WN, and Cr. (Paragraph 51). The Office Action asserts that Dalton's liner layer (24) is equivalent to the "binding layer" of the present invention. (Office Action at 4). Dalton, however, does not disclose any such "binding layer," nor does he disclose that the liner layer (26) or the preferred materials for forming the liner layer would also function as a "binding layer," as required by claim 1. Thus, the liner layer (26) of Dalton is not analogous to the "binding layer" of the present invention. Since all of the limitations of claim 1 are not disclosed by Dalton, the subject matter of claim 1 is not anticipated under 35 U.S.C. § 102(a). Claim 2 depends from claim 1 and is therefore allowable with claim 1 for at least the reasons given above. Applicants respectfully request that the rejection be withdrawn.

Independent claim 7 is similar to claim 1, but recites an electrode structure comprising "a conductive binding layer," wherein the binding layer "is selected to provide adhesion between the first and second layers to prevent the second layer from being forced out of the opening in the dielectric layer by forces created by a chemical/mechanical planarization process being applied to the electrode structure." As discussed above, Dalton does not disclose a "binding layer," let alone a "conductive binding layer." Furthermore, Dalton does not disclose a binding layer selected "to prevent the second layer from being forced out of the opening in the dielectric layer by forces created by a chemical/mechanical planarization process," as required by claim 7. Since all of the limitations of claim 7 are not disclosed by Dalton, the subject matter of claim 7 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Claim 8 is similar to claim 1 and is therefore allowable for at least the reasons set forth for claim 1. Specifically, claim 8 recites "an electrode structure," comprising "a first layer of metallization," "a binding layer formed on the dielectric layer and on the exposed portion of the surface of the first layer," and "a second layer of metallization formed on the binding layer." As discussed above, Dalton does not disclose such a "binding layer." Since all of the limitations of claim 8 are not disclosed by Dalton, the subject matter of claim 8 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 12 is similar to independent claim 7 and is therefore allowable for at least the reasons set forth for claim 7. Specifically, claim 12 recites an electrode structure comprising "a binding layer," wherein the binding layer "is selected to provide adhesion between the first and second layers to prevent the second layer from being forced out of the opening in the dielectric layer by forces created by a chemical/mechanical planarization process being applied to the electrode structure."

As discussed above, Dalton does not disclose such an electrode structure. Since all of the limitations of claim 12 are not disclosed by Dalton, the subject matter of claim 12 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 15 is similar to claim 1, but recites an "electrode structure," comprising a "conductive binding layer, wherein the conductive binding layer includes a silicon dioxide and metal diffused from the second layer." As discussed above, Dalton does not disclose any such binding layer. Furthermore, "silicon dioxide and metal diffused from the second layer," are not listed among nor are they similar to the example liner layer materials disclosed by Dalton. (*see* paragraph 51). Since all of the limitations of claim 15 are not disclosed by Dalton, the subject matter of claim 15 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 40 recites a "semiconductor die," having an electrode structure as claimed in claim 1 and is therefore allowable for at least the reasons set forth in claim 1. As discussed above, Dalton does not disclose such a "binding layer." Since all of the limitations of claim 40 are not disclosed by Dalton, the subject matter of claim 40 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 41 recites a "semiconductor die," having an electrode structure as claimed in claim 15 and is therefore allowable for at least the reasons set forth for claim 15. Since all of the limitations of claim 41 are not disclosed by Dalton, the subject matter of claim 41 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 42 recites a "semiconductor die," having an electrode structure as claimed in claim 12 and is therefore allowable for at least the reasons set forth for claim 12. Since all of the limitations of claim 42 are not disclosed by Dalton, the subject matter of claim 42 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 43 recites a "semiconductor die," having an electrode structure as claimed in claim 7 and is therefore allowable for at least the reasons set forth for claim 7. Since all of the limitations of claim 43 are not disclosed by Dalton, the subject matter of claim 43 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

Independent claim 95 is similar to independent claim 1 and is therefore allowable for at least the reasons set forth for claim 1. Specifically, claim 95 recites "an electrode structure," comprising "a first layer of conductive material," "a binding layer formed on a surface of the first layer," and "a second layer of conductive material formed on the conductive binding layer." As discussed above, Dalton does not disclose such a "binding layer." Since all of the limitations of claim 95 are not disclosed by Dalton, the subject matter of claim 95 is not anticipated under 35 U.S.C. § 102(a). Applicants respectfully request that the rejection be withdrawn.

35 U.S.C.§ 103 Rejections

Claims 1-2, 6-16, 40-43, and 95-96 stand rejected as being unpatentable over Dalton in view of Kozicki et al. (US 2002/0168820 A1) ("Kozicki"). Applicant respectfully traverses this rejection.

Kozicki relates to a microelectronic programmable structure. (Abstract). According to Kozicki, the programmable structure comprises a bottom electrode (130), an

ion conductor (140), a barrier layer (155), and a top electrode. (FIG. 1). The ion conductor (140) is formed of a chalcogenide material "with dissolved metals and or metal ions," such as glasses having the general formula Ge_xS_{1-x}-Ag. (Paragraph 53). The ion conductor (140) is formed by dissolving Ag into a chalcogenide glass. (Paragraph 54) Kozicki also discloses that the ion conductor "may include a filler material, which fills interstices or voids [in the chalcogenide glass matrix]." (Paragraph 59). The Office Action asserts that Dalton teaches the same electrode structure as the instant invention, "but does not use silicon dioxide." To overcome this drawback, the Office Action relies on Kozicki, stating that Kozicki "teaches an ion conductor (140) of silicon oxide between a conductor (130)... and [an] electrode (120)." The Office Action further asserts that it would have been obvious for one of skill in the art "to substitute the filler material of the ion conductor of silicon oxide of Kozicki [for] the liner/binding layer of Dalton because the substitution would improve the diffusion prevention and adhesiveness between the second conductor and first conductor as taught by Dalton." (Office Action at 5).

As described above, Dalton relates to interconnect structures for high-speed integrated circuits that contain a liner layer/diffusion barrier layer (26). (Dalton at paragraph 1). The copper interconnect structure disclosed in Dalton comprises a substrate layer (10), a dielectric layer (12), an opening in said dielectric layer (24), a liner layer (26), a copper layer (28) and a cap (30). (FIGS. 1A-F) Dalton discloses that the liner layer (26), "includes any material which would prevent the diffusion of Cu into the dielectric layers." (Paragraph 51).

The subject matter of claims 1-2, 6-16, 40-43, and 95-96 would not have been obvious over Dalton in view of Kozicki, because neither Kozicki nor Dalton provide motivation to one of ordinary skill in the art to combine their teachings to arrive at the claimed invention. Neither Kozicki nor Dalton teach or suggest binding layers, nor do they teach or suggest that the functional layers of their respective devices require any specialized treatment in order to promote layer adhesion. Furthermore, Kozicki teaches

silicon dioxide as an additive to an ion conductor layer (140) to promote more stable device switching. (Paragraph 59). Thus, Kozicki provides no motivation to one of skill in the art to use the silicon oxide filler material independently from the ion conductor (140). Moreover, Kozicki provides no motivation to combine such filler material with the liner layer of Dalton to arrive at the claimed invention.

Even if sufficient motivation exists to combine Kozicki and Dalton, the subject matter of claims 1-2, 6-16, 40-43, and 95-96 would not have been obvious over Dalton in view of Kozicki, because the combined references fail to teach or suggest all claim limitations.

As discussed above, Dalton fails to disclose "electrode structures " having "binding layers," as required by claims 1, 8, 12, 40, 42, and 95. Similarly, Dalton fails to disclose "electrode structures " having "conductive binding layers," as required by claims 7, 15, 41, and 43. Independent claim 14 is similar to independent claim 15 and recites an electrode structure comprising a "conductive binding layer, wherein the conductive binding layer includes an oxide and silver diffused from the second layer into the oxide." As discussed above, Dalton does not disclose any such binding layer, nor does it disclose any layer comprising, "an oxide and silver diffused from the second layer into the oxide," as require by claim 14. Independent claim 6 is similar to claim 1, but recites an "electrode structure" comprising, "a binding layer including a silicon dioxide," and "a second layer of conductive material formed on the binding layer, wherein the conductive material of the second layer is selected to be diffusible into the binding layer to make the binding layer capable of conducting electrical current." As discussed above, Dalton does not disclose such a "binding layer." Furthermore, Dalton does not disclose a conductive material "selected to be diffusible into the binding layer," as required by claim 6.

Moreover, Kozicki does not teach or suggest the use of an ion conductor (140) as a "binding layer," as required by claims 1, 6, 8, 12, 40, 42, and 95, nor a "conductive binding layer," as required by claims 7, 14, 15, 41, and 43. Furthermore, Kozicki does not teach or suggest that the ion conductor material can "improve the adhesiveness," between the layers taught by Dalton, as the Office Action asserts. Instead, Kozicki discloses that the ion conductor (140) is used as the key switching component in a programmable microelectronic memory structure (Paragraph 37). As such, the ion conductor (140) "is formed of a material that conducts ions upon application of an electric field." (Paragraph 52). As discussed above, the ion conductor (140) disclosed by Kozicki is formed from a chalcogenide glass having metals or metal ions dissolved therein. (Paragraph 53). While the ion conductor (140) may also include a filler material of silicon oxide, this filler material is an additive used to promote "more stable [memory] device operation," and "to reduce the cross-sectional area of the ion conductor." (Paragraph 59). Thus, Kozicki does or teach or suggest that the ion conductor (140) would be suitable as a binding layer. Furthermore, Kozicki does not teach or suggest that the silicon oxide filler material could be used independently from the ion conductor (140) to form a binding layer.

For at least these reasons, the Office Action fails to establish that either Dalton or Kozicki provides a motivation for one of skill in the art to combine these references to arrive at the claimed invention. Furthermore, even if Dalton and Kozicki are so combined, their combination fails to teach or suggest all claim limitations of the present invention. Thus, the office action fails to present a prima facie case for obviousness. Claims 9-11 depend from claim 8 and are therefore allowable for at least the reasons set forth for claim 8. Claim 13 depends from claim 12 and is therefore allowable for at least the reasons set forth for claim 12. Claim 96 depends from claim 95 and is therefore

allowable for at least the reasons set forth for claim 95. Withdraw of this rejection is respectfully requested.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. According, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

By _____

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